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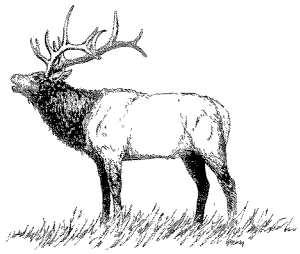


Point Reyes National Seashore
Fall 2001 Horseback Tule Elk Census, Tomales Point
N. Gates, Wildlife Biologist

Summary:

Three elk counts were done from horseback at Tomales Point on October 10, 18 and Nov 1, 2000. On each occasion, 3 teams surveyed defined sectors of the elk reserve and generated the data outlined in the attached table. The highest total count was 423 elk on October 18. This is 28 animals fewer than last year's maximum fall count. Fewer calves, cows and non-yearling bulls were counted this year than last. An attempt was made to classify animals into 5 age categories and, like last year, all visible collars were counted in an unsuccessful effort to obtain a sightability estimate. Future censuses should incorporate use of a park boat crew to assist in counting animals bedded near Tomales Bay. Calf:Cow ratios and Bull: Cow ratios appear to be decreasing since 1999 concomitant with a slight decrease in total numbers. It seems unlikely that yearly contraception of approximately 45 cows is the sole cause for the cessation of herd growth. Monitoring of female fecundity and calf survival rates is recommended over the next few years. If current precipitation patterns and range conditions persist, discontinuation of the contraception program is not expected to result in renewed population increases.

Methods:

The Tomales Point elk reserve was divided into 3 sections, based on estimated time needed to census and past evidence that marked animals rarely move in large numbers between the area north of "Water Tank" to south of the northern edge of White Gulch. The boundary between the northern section and the middle section was an east-west line drawn through experimental exclosure OGL2, near the trail on the northern ridge overlooking White Gulch (see Appendix 1). The boundary between the middle and southern sections was a line drawn from the water storage tower just east of Upper Pierce Ranch to the bay, and to the McLure's Beach trail and on to the ocean (Appendix 1). Each team consisted of 2 people on horseback, except for October 10, when one person on horseback surveyed the northern section alone. In areas where there was a high probability of animals crossing over the boundary from one section to another, the two teams surveying these adjacent sections began their survey together, on the boundary, and moved off in opposite directions. This minimized any chance that animals would be counted twice in the two different sections. Teams surveyed their respective sections only once, again in an effort to minimize double counting. As teams moved across their sections, they made an effort to travel through all accessible areas. For areas that were too brushy or steep, overlooking vantagepoints were used. At these vantagepoints, time was spent observing inaccessible areas for movement or antlers, in the case of foraging or bedded bulls. On November 1, 2001, a crew of observers on board the PORE LE Ranger boat attempted to flush animals that might be bedded close to Tomales Bay, in areas not visible to the horseback observers. Animals that were too far from the water to flush but were judged difficult to see from land, were identified by the boat crew and marked their locations on a map for future comparison with land crew counts.

Observed animals were identified as either cows, calves, spikes (1 year-old males), raghorns (2 year-old males, with 2-4 points per antler) or prime bulls ($\geq$3years, >4 points per antler). During the first count, animals were assigned to only 4 groups, cows, calves, spike and branch-antlered bulls ($\geq$2 years). On the

two later counts, radio-telemetry collars on cows were counted. Each team recorded data using a pocket tape recorder and marked locations on a topographical map.

Results:

A total of 407, 423 and 421 animals were counted on the three census days (see Table 3). Weather was windy and foggy during all of October 18 and the afternoon of November 1, with warm weather and good visibility on October 10 and in the morning of November 1. On October 18, when the maximum number of animals (423) was counted, observers classified 254 cows (yearlings and older), 50 calves, 22 spikes, 12 raghorns and 82 bulls (4 years and older). Calf:cow (c:C) and bull:cow (B:C) ratios over the 3 census days in 2001 were averaged and yielded a mean c:C of 0.23 and a mean B:C of 0.49. See table 1 for mean ratios for 1999 and 2000. T-tests performed to compare the mean c:C and B:C in 2000 and 2001 suggest that the differences in mean ratios between the two years are not statistically significant ($p \geq 0.2$ for both comparisons). In fact, in comparing mean ratios for 1999,2000 and 2001, the only statistically significant differences were between 1999 and 2001 mean B:C ratios. Between the 1999 and 2001, the average Bull:Cow ratio dropped significantly ($p<0.05$).

Table 1: Composition Ratios, Elk Censuses 1999-2001

	Mean Calf:Cow	St. Dev.	Mean Bull:Cow	St. Dev.
1999	0.29	0.15	0.73*	0.11
2000	0.29	0.06	0.55	0.05
2001	0.23	0.04	0.49*	0.07

* Statistically significant difference at 0.05 level

Comparison of the 2000 and 2001 highest counts (Table 2) show that, with the exception of spike bulls, which increased in 2001, fewer animals in all age-sex class categories were counted this year. (Raghorn bulls were not differentiated from bulls ≥ 3 yr. old during the highest yield count of 2000.) Weather conditions for this year's counts were comparable to last year's although, unlike last year, the highest count this year occurred on the foggiest, windiest day and the lowest total count occurred on the sunniest, warmest day.

Table 2: Highest Counts from 1999- 2001 Tomales Point Censuses

	Total	Cows	Calves	Unknown	Spike Bulls	Branch-Antler Bulls ($\geq$ 2 yr.)	Total Bulls
Nov 23 1999	476	210	92		Not counted	Not counted	174
Oct 11 2000	451	260	61		17	113	130
Oct 18 2001	423	254	50	3	22	94	116

Also counted during this year's census were: 4 calf carcasses, a maximum of 19 black-tailed deer on one day (November 1, 2001), 2 scouring elk on one day (1 spike and 1 raghorn) and 1 fallow deer buck southeast of Upper Pierce Ranch (November 1, 2001).

Table 3: 2001 Tomales Point Tule Elk Censuses												
10/10/01							Weather: sunny, warm					
	Observers	Total	Cows	Calves	Unknown	Spike Bulls	Raghorn Bulls	Prime Bulls	Total Bulls	calf:Cow	Bull:Cow	Collars
South	Binney,Stone	143	70	26		11	7	29	47	0.37	0.67	
Mid	Atkinson,Geritz	112	87	14		6	2	3	11	0.16	0.13	
North	Gates	152	86	17		3	13	33	49	0.20	0.57	
Total		407	243	57		20	22	65	107	0.23	0.44	
10/18/01							Weather: foggy					
	Observers	Total	Cows	Calves	Unknown	Spike Bulls	Raghorn Bulls	Prime Bulls	Total Bulls	calf:Cow	Bull:Cow	Collars
South	Atkinson, Binney	105	37	10	3	9	5	41	55	**0.27**	**1.49**	8
Mid	Fallon, Stone	129	105	13		7	0	4	11	**0.12**	**0.10**	17
North	Gates, Shepard	189	112	27		6	7	37	50	**0.24**	**0.45**	27
Total		423	254	50	3	22	12	82	116	0.20	0.46	52
11/1/01							Weather: sunny in a.m., foggy after 14:00					
	Observers	Total	Cows	Calves	Unknown	Spike Bulls	Raghorn Bulls	Prime Bulls	Total Bulls	calf:Cow	Bull:Cow	Collars
South	Binney, Hadland	174	92	20		9	3	50	62	**0.22**	**0.67**	11
Mid	Atkinson, Stone	54	27	16		7	2	2	11	**0.59**	**0.41**	5
North	Gates, Geritz	193	111	25		6	8	43	57	**0.23**	**0.51**	27
Total		421	230	61		22	13	95	130	0.27	0.57	43

Discussion:

For the reasons outlined in the fall 2000 census report (Gates 2000), it is unlikely that a significant number of animals were double-counted during the census. It is more likely that not all animals present on the elk range were counted. For these reasons, the highest of the three counts, 423 animals, from October 18, 2001 should be used as a current minimum population estimate. Very little rut activity was observed this year in comparison to last year, in spite of near identical timing of the first two counts in early and mid-October. In an effort to gain sightability estimates for Tomales Point cows, all collars were counted on 2 of the 3 days. Unfortunately the condition and appearance of the aging collars, now 4 to 6 years old, makes them difficult to see, especially when cows are bedded. In addition, because fewer than half of the collars at Tomales Point have installed mortality modes, it is nearly impossible to know, at any given time, how many collared cows are alive. Once again, it seems unlikely that counting collars will increase the accuracy of the yearly elk censuses and it should probably be discontinued.

To count animals that might be bedded under cover near Tomales Bay, an LE ranger and wildlife biotechnician assisted during the last count (November 1, 2001) in flushing animals near the bay from the PORE boat. Counts of animals flushed and seen in areas judged unobservable by the horseback crews comprise a total of 8 bulls, or 8% of all prime bulls counted that day. It is likely that using observers by boat on the highest count day, October 18, 2001, might have resulted in a higher minimum count for this year. This additional surveillance should be incorporated into any future census plans along with improved communication between boat and land crews curing the census.

Although it is impossible to estimate "missed" animals with any scientific certitude, a best guess for the maximum number of animals missed, mostly males, would be 25. Such a guess is based on knowledge of usual elk densities in areas which are difficult to observe. Consequently, it is unlikely that the elk population at Tomales Point exceeds 450 animals. Last year's minimum population estimate was 451, and if as many animals were missed in 2000 as in 2001, there appear to be fewer elk at Tomales Point this year.

Because of their large size, some older (>6 months) calves of the year may have been misclassified this year as yearlings and the true calf:Cow ratio may actually be higher than 0.23. There is however, no reason to think that more calves were misclassified this year than last because the censuses were conducted at the same time of the year, with observers of similar experience levels and under similar weather conditions. With the exception of spike males, which increased in number over last year, fewer elk of all age and sex groups were counted in this year's census. Along with the statistically insignificant decrease in calf:Cow ratios these data lead to one of the following conclusions:

1. This year's overall population decrease is due, not to a decrease in reproductive success (lower fecundity and/or lower calf recruitment), but to overall decreased survival in all age groups, with the possible exception of yearling (spike) males,
2. The statistically insignificant decrease in calf:Cow ratios this year over last is an artifact of a small "n", sample size. Had we conducted more censuses, and obtained similar results, the difference between a c:C of 0.29 in 2000 and 0.23 in 2001 might be significant to the 0.05 level.

The second possibility seems more consistent with accepted theories of elk demographic shifts in decelerating populations, which predict decreases in cow fecundity and calf survival before decreases in adult survival (Gogan et al 1987, Clutton-Brock et al 1982, Houston 1982).

Forty-three cows were boostered with porcine Zona Pellucida (pZP), a contraceptive vaccine, in fall of 2000 (Gates 2001). In light of steady or slightly declining calving rates in untreated control animals (from 58% in 2000 to 56% in 2001), it was estimated that thirteen 2001calves were prevented with contraceptive use compared to sixteen 2000 calves prevented. If calf:Cow ratios are indeed falling, it seems unlikely that the contraceptive program, which is becoming less "effective" in preventing calves, is a major cause. Accurate determination of whether or not cow fecundity rates are decreasing would entail necropsy of a

sample of untreated cows or measurement of pregnancy rates via fecal hormones. Obtaining calving rates would entail capturing, radio-collaring and monitoring a new cohort of 20-30 cows.

If the 2000 calf count of 61 is considered accurate and the calf sex ratio remains approximately 1:1 (Gogan and Barrett 1987, and Howell et al, 2000), this year's count of 22 spike males would suggest a surprisingly high survival rate of 0.72 (28% mortality) for males between the ages of 1-6 months and 13-18 months. Because yearling females cannot reliably be differentiated from older cows, a corresponding female calf survival rate cannot be derived. Howell estimated 1998 Tomales Point calf survivorship at 0.86 (mortality of 14%), based on the survival of 24 out of 28 tagged calves from spring until the fall herd count (Howell et al 2000). In the Owens Valley, McCullough estimated a calf survival rate of 0.38 (62% mortality) for the 0-1 year class and similar mortality rates for male and female calves (McCullough 1969). Determining true current calf survival rates at Tomales Point would entail radio-collaring a sample of 2002 calves this spring.

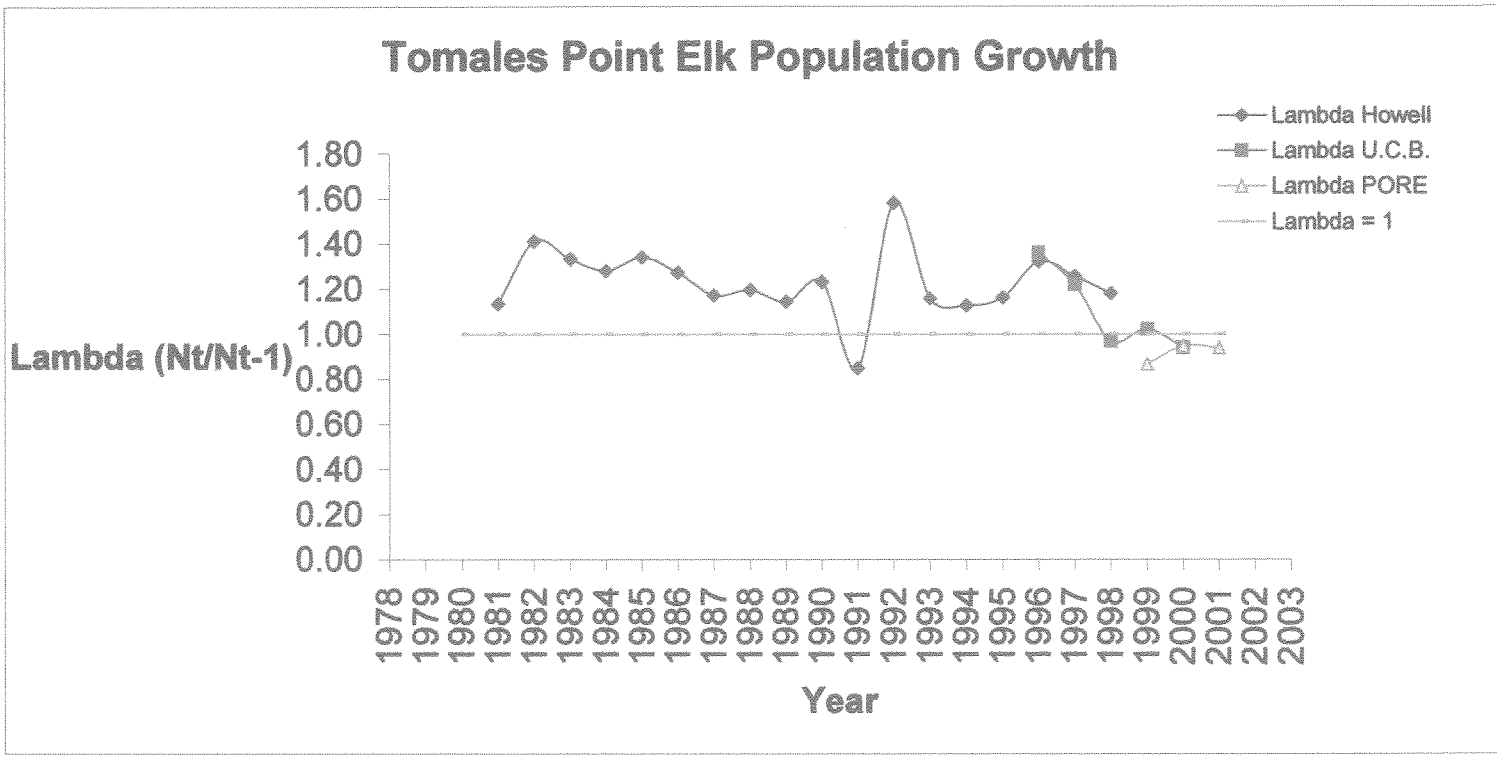
This year's Bull:Cow ratio is not significantly lower than last year's (again, possibly due to a small sample size), however there is a statistically significant decrease in B:C from 1999 to 2001. This decrease may indicate increased bull mortality, another predicted demographic shift in populations approaching carrying capacity (Clutton-Brock et al 1982).

Lower calf and bull survivorship as well as decreased cow fecundity could all be associated with a population near or at carrying capacity for the range after a number of low precipitation years. Annual precipitation at Bodega Bay Marine Laboratory for the past 2 years (2 yr. average = 23.37 in./yr.) has been lower than the 35-year average (33.78 in./yr.)(Bodega Bay Marin Laboratory data, V. Chow, pers. comm). This year's monitoring of Residual Dry Matter (RDM) on Tomales Point may indicate decreased available forage (M. Homrighausen, pers. comm.).

The role of paratuberculosis, or Johne's disease, in limiting population growth is an unknown factor. The disease, endemic in the Tomales Point herd, is thought to cause clinical signs years after infection and causes increased mortality in adult cattle. The epidemiology of the disease in elk is unknown but it is probable that, like in cattle, transmission and predisposing stresses are exacerbated by increased animals density.

In conclusion, the total population size at Tomales Point, as counted by horseback censuses this fall, appears to be stable or decreasing slightly. Growth rates (λ) have been decreasing since 1996 and have been <1 since 1999 (Figure 1). Calf: Cow ratios and Bull:Cow ratios have decreased since 1999, indicating falling bull survivorship as well as decreasing birth rates and/or calf survivorship. Contradictory evidence of increased calf survivorship , i.e., increased spike bull numbers in 2000, highlight the need to directly measure calf survivability in 2002.

Figure 1:


Tomales Point Elk Population Growth
Lambda Howell
Lambda U.C.B.
Lambda PORE
Lambda = 1
Lambda (Nt/Nt-1)
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1978
1979
1980
1981
1982
1983
1984
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1986
1987
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1998
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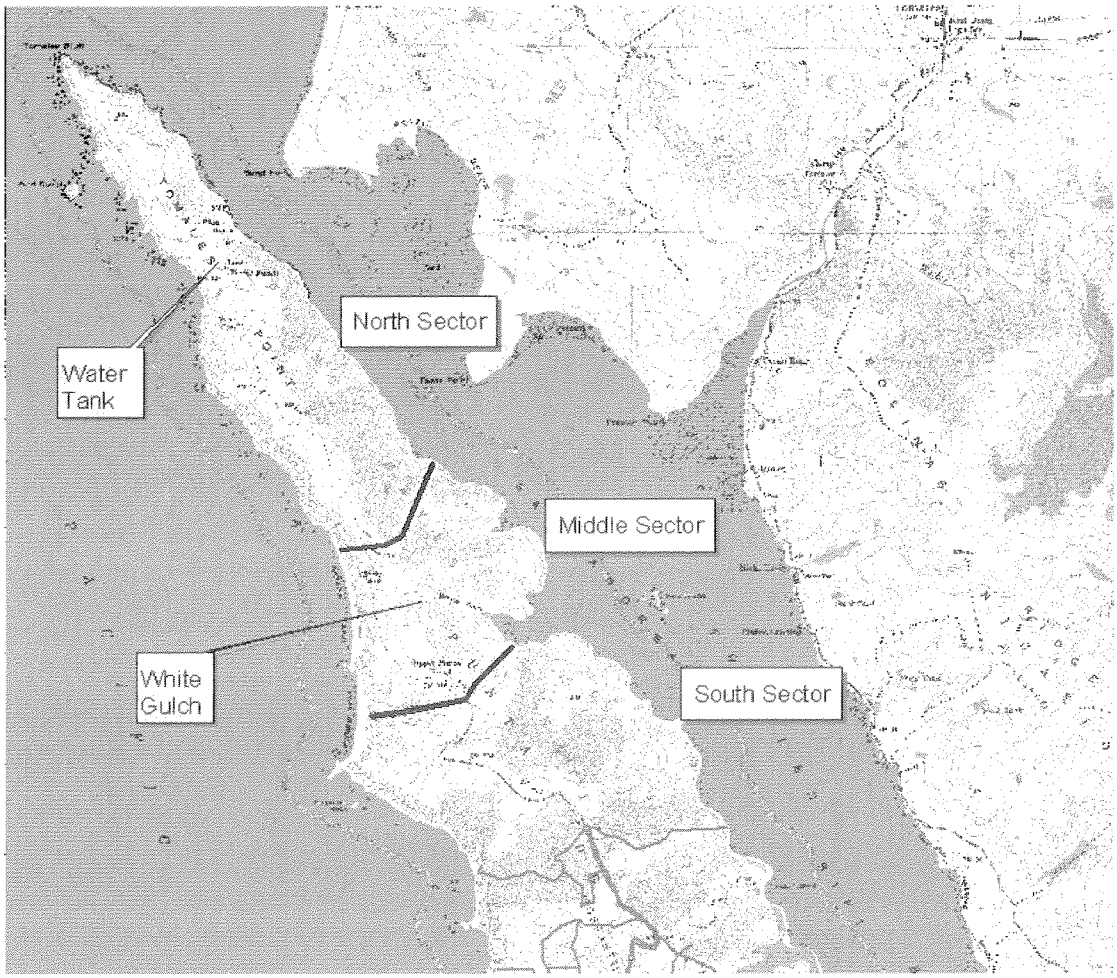
Year

Appendix 1: Fall 2001 Tomales Point Elk Census



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